AMENDED SPECIFICATION

➢ **Please replace the paragraph at page 4, lines 8-13 with the following:**

Valves with even greater numbers of flow direction are also well-known. Still further, the following are also well-known: direct operated valves, such as ~~D0-3, DO-5, DO-5H, DO-8, DO-8H, and DO-10, DO-10H~~ DO3, DO5, DO5H, DO8, and D10, and the like; pilot controlled valves, which use a pilot spool to control the sliding spool; on-off valves, including wet and dry armature on-off valves; proportional control valves; servo (also known as feedback) valves; and many techniques for pneumatic, hydraulic, and other valve amplification.

➢ **Please replace the paragraph at page 4, lines 17-22 with the following:**

A valve base module is disclosed, comprising a valve housing having a longitudinal bore extending about a longitudinal axis; a valve element disposed within said longitudinal bore, said valve element having one or more lands that divide said longitudinal bore into a plurality of chambers; and a tank core passage connecting at least some of said chambers, said tank core passage extending ~~through~~ within a ~~non-vertical~~ plane ~~defined by~~ containing said longitudinal axis ~~and a non-vertical cross-section extending through said valve housing~~, said plane oriented in non-perpendicular relation to a surface of said valve housing comprising at least a P, T, A, and B port and standard mounting holes for mounting said valve base module to at least one of a sub-plate or bar manifold.

➢ **From page 5, line 18 through page 7, line 11, please replace the Brief Description of the Several Views of the Drawings with the following:**

FIG. 1 is a prior art control valve, shown in top view (1-A), cross-sectional view (1-B), and partial bottom view (1-C);

FIG. 2 is a digitally controlled modular control valve system, comprising four primary modules, including a valve base module ("VBM"), pilot control module ("PCM"), thermal insulator module ("TIM"), and power supply module ("PSM"), shown in top view (2-A), partial cross-sectional view (2-B)~~;~~, partial bottom view (2-C)~~;~~, and side view (2-D);

FIG. 3 is a detail view of the VBM of FIG. 2, shown in partially cut-away top view (with partial cross-sectionals) (3-A)~~;~~, cross-sectional view (3-B)~~;~~, and partial bottom view (3-C);

FIG. 4 is a detail view of the PCM of FIG. 2, shown in partially cut-away top view (with partial cross-sectionals) (4-A)~~;~~, cross-sectional view (4-B)~~;~~, and partial bottom view (4-C);

FIG. 5 is a detail view of a pilot control valve assembly ("PCVA") of FIG. 4, shown in cross-sectional view;

FIG. 6 is a graph of modulation ratio verses control pressure of the PCVA of FIG. 5;

FIG. 7 is a detail view of the TIM of FIG. 2, shown in top view;

FIG. 8 is a detail view of the PSM of FIG. 2, shown in top view (8-A), partial cross-sectional view (8-B), and partial bottom view (8-C);

FIG. 9 is a modular control valve system comprising four primary modules, including the VBM, PCM, TIM, and PSM of FIG. 2, and five optional modules, including a pressure reducing module ("PRM"), diagnostic module ("DM"), load sense module ("LSM"), position feedback sensor module ("PFSM"), and manual override manual ("MOM"), shown in top view (9-A), partial cross-sectional view (9-B), partial bottom view (9-C), and side view (with partial cross-sectionals) (9-D);

FIG. 10 is a detail view of the PRM of FIG. 9, shown in partially cut-away top view (with partial cross-sectionals) (10-A), partial cross-sectional view (10-B), and partial bottom view (10-C);

FIG. 11 is a detail view of the pressure reducing valve cartridge ("PRVC") of FIG. 10, shown in cross-sectional view;

FIG. 12 is a detail view of the DM of FIG. 9, shown in partially cut-away top view (12-A), partial cross-sectional view (12-B), and ~~(C)~~ bottom view (12-C);

FIG. 13 is a detail view of the LSM of FIG. 9, shown in partially cut-away top view (13-A), partial ~~(B)~~ cross-sectional view (13-B), and ~~(C)~~ bottom view (13-C);

FIG. 14 is a detail view of the PFSM and MOM of FIG. 9, shown in partially cut-away top view (with partial cross-sectionals) (14-A), partial cross-sectional view (14-B), and partial bottom view (14-C);

FIG. 15 is a modular control valve system according to the present invention, including sub-plate mounting, shown in top view; ~~and~~

FIG. 16 is a modular control valve system according to the present invention, including bar manifold mounting, shown in top view; ~~and~~

FIG. 17 is a electronic control module for remote operation of the PCM and PSM, shown in top view (with cover removed) (17-A) and side view (17-B);

FIG. 18 is a standard DO5 valve pattern;

FIG. 19 is a standard DO8 valve pattern; and

FIG. 20 is a chart of relationships between various standard mounting patterns from various standard-setting bodies.

➢ **Please replace the paragraph at page 7, line 14 through page 8, line 6 with the following:**

Referring now to FIG. 1, a prior art apparatus 10 is shown comprising a valve housing 12 in physical and electrical contact with a junction box 14 having one or more passages for wire conduit 15 at distal ends thereof. A longitudinal bore 16 extends about a longitudinal axis L-L of the valve housing 12, into which a sliding spool 18 is precision-fit The sliding spool 18 contains one or more lands 20 that divide the longitudinal bore 16 into one or more chambers 22. Alternatively, it can also be directly machined into the valve housing 12 without a cartridge design, as well-known in the art. Regardless, through operation and positioning of the sliding spool 18, the one or more chambers 22 can be made to align with a pressure port P, one or more tank ports T, and one or more working ports A, B, as well-known in the art. While the pressure port P connects to a pressure flow source (not shown), the two working ports A, B connect to one or more actuating units (not shown). Thus, looking generally left to right along the longitudinal axis L-L in ~~view (B)~~ FIG. 1-B, the five chambers are T, A, P, B, and T, whereby the first and last tank ports T are connected through a well-known tank core passage 24. As well-known in the art, the tank core passage 24 extends through a vertical plane V defined by the longitudinal axis L-L extending through the longitudinal bore 16 of the valve housing 12 and a vertical cross-section extending through the valve housing 12.

➢ **Please replace the paragraph at page 10, lines 1-12 with the following:**

Consistent with well-known industry standards, a bottom surface 38 of the valve housing 12 contains four passages extending therethrough for alignment and communication with the four ports P, T, A, and B. O-ring sealing about the passages is common for preventing leakage. The bottom surface 38 can also optionally contain a load sense port L, drain port D, pressure port Pr, and four mounting holes 40 for securing a ~~subplate~~ sub-plate (not shown) to the valve housing 12 by techniques well-known in the art. Because the bottom surface 38 ~~is~~ can be geometrically symmetrical, ~~a~~ an optional locating pin 42 ~~is also~~ can be commonly provided for alignment purposes. The bottom surface 38 complies with current mounting patterns of the National Fluid Power Association and ("NFPA"), Joint Industrial Council ("JIC"), Comité

Européen des Transmissions Oléohydrauliques et Pneumatiques ("CETOP"), and International Organization for Standardization ("ISO"), and is suitable for both sub-plate and bar manifold mounting. Hereinout, this generalized arrangement is referred to as a standard mounting pattern 44, with FIGS. 1-C, 2-C, 3-C, 4-C, 9-C, 10-C, 13-C, 14-C showing a standard DO3 valve pattern, FIG. 18 showing a standard DO5 valve pattern, FIG. 19 showing a standard DO8 valve pattern, and FIG. 20 showing a chart of relationships between various standard mounting patterns from various standard-setting bodies.

➢ **Please replace the paragraph at page 10, line 17 through page 11, line 7 with the following:**

Referring now to FIG. 2, a modular apparatus 50 is shown comprising four primary modules, including a valve base module ("VBM") 52, pilot control module ("PCM") 54, thermal insulating module ("TIM") 56, and power source module ("PSM") 58. The PSM 58 is in physical contact with the TIM 56. The TIM 56 is in physical contact with, and preferably disposed between, the PSM 58 and PCM 54. The PCM 54 is in physical contact with, and preferably disposed between, the TIM 56 and VBM 52. The VBM 52 is in physical contact with the PCM 54. And preferably, the PSM 58 is disposed above the TIM 56, which is disposed above the PCM 54, which is disposed above the VBM 52 relative to a vertical plane V defined by the longitudinal axis L-L extending through the longitudinal bore 16 of the valve housing 12 and a vertical cross-section extending through the valve housing 12. Furthermore, the PCM 54 is in electrical contact with the PSM 58 through one or more electrical leads 60 that extended through one or more passages 62 in the TIM 56. Otherwise, the TIM 56 thermally isolates the PSM 58 from the PCM 54 and VBM 52. Other relationships between the VBM 52, PCM 54, TIM 56, and PSM 58 will be discussed hereinout.

➢ **Please replace the two (2) paragraphs at page 11, line 17 through page 12, line 9 with the following:**

Also similar to the prior art apparatus 10 of FIG. 1, looking generally left to right along the longitudinal axis L-L in ~~view (B)~~ FIG. 3-B, the five chambers are T, A, P, B, and T, whereby the first and last tank ports T are connected through a tank core passage 24'. However, the new tank core passage 24' of the modular apparatus 50 no longer extends through the vertical plane V defined by the longitudinal axis L-L extending through the longitudinal bore 16 of the valve housing 12 and a vertical cross-section extending through the valve housing 12 (as shown, for

reference purposes only, as dashed lines in the vertical plane V). Rather, the new tank core passage 24' preferably extends through a horizontal plane H defined by the longitudinal axis L-L extending through the longitudinal bore 16 of the valve housing 12 and a horizontal cross-section extending through the valve housing 12.

It should be recognized, of course, that the horizontal plane H, as depicted, could also be rotated 180° about the longitudinal axis L-L in order to be aligned with the position of the new tank core passage 24' that is shown in ~~view (A)~~ FIG. 3-A, but for ease of representation purposes, this has not been done. In other words, the foregoing recognizes and contemplates that the horizontal plane H extends, obviously, through the longitudinal axis L-L and is otherwise infinite in expanse.

➢ **Please replace the two (2) paragraphs at page 15, line 19 through page 16, line 15 with the following:**

With on-off operation, the PCVA coil 86 is electrically energized with either high or low (i.e., full or zero) voltage or current, such as 12 volts DC or 0 volts DC from the PSM 58. When the PCVA coil 86 is subjected to the high voltage (i.e., 12 volts DC) or current, then the PCVA sliding spool 84 directs flow from the regulated pressure port Pr to the control pressure port Pc, blocking the drain pressure port D, which, in turn, feeds control pressure from the control pressure port Pc to the FIC 76 through the FIP 77 to the VBM ~~12~~ 52. This pressure thus acts against a sliding spool 18 to create sufficient force to overcome the preloaded force created by a centering spring 34 at a distal end thereof. In turn, the transfer of the high voltage or current signal to the PCVA 80 through the PSM 58 controls positioning of the PCVA sliding spool 84 in the longitudinal bore 16 of the VBM 52 to achieve a position relative to the one or more chambers 22 of the VBM 52.

When there is a lack of voltage or current to the PCVA coil 86, the PCVA sliding spool 84 achieves its original position due to the preloaded PCVA null adjustment spring 87, where the regulated pressure port Pr is blocked, and the control pressure port Pc connects to the drain pressure port D, which drains the FIP 77 through the FIC 76 of the VBM ~~12~~ 52. This pressure thus acts against the sliding spool 18 to return it to its original position created by the centering spring 34 at a distal end thereof. In turn, the transfer of the low voltage or current signal to the PCVA 80 through the PSM 58 controls positioning of the PCVA sliding spool 84 in the

longitudinal bore 16 of the VBM 52 to achieve its center, or commonly known as neutral, position relative to the one or more chambers 22 of the VBM 52.

➢ **Please replace the three (3) paragraphs at page 20, line 16 through page 21, line 23 with the following:**

In a preferred embodiment, the power supply or PWM circuit board 100 is capable of at least the following functionality: i) DC to DC power supply conversion, ii) AC to DC power supply conversion, iii) PWM operation for proportional circuit control, and iv) PWM operation for servo operation circuit control. For example, the DC to DC power supply preferably converts a 12-48 volts DC ~~inputs~~ input to a 12 volts DC output at 1 amp to drive the PCVA solenoids 84. The AC to DC power supply preferably converts a 120-240 volts AC input to a 12 volts DC output at 1 amp to drive the PCVA solenoids 84 at 50-60 Hertz, thereby accommodating all standardized voltages and frequencies used throughout the world. Thus, whereas the prior art apparatus ~~50~~ 10 required changing the one or more high power solenoids 26 for different input voltages and frequencies, the modular apparatus 50 enables standardization. Among other things, this standardization reduces manufacturing costs, allows efficiencies to be derived from common hardware, decreases inventories of additional coils, and facilitates easier field support and changes. In addition, the PWM operation for the PSM 58 is substantially similar for on-off control, proportional control, and servo control, as previously elaborated upon.

Whereas the prior art apparatus 10 required attaching one or more high power solenoids 26 to the sliding spool 18, the preferred PSM 58 is a low-power device. More specifically, the one or more high power solenoids 26 required relatively high forces to act, and overcome, the flow forces generated during activation of the prior art apparatus 10, which, in turn, required relatively high current levels to generate sufficient forces. The modular apparatus 50, on the other hand, acting through the PCM 54 and PSM 58, has eliminated the need for one or more high power solenoids 26. In particular, the PCM 54 preferably utilizes hydraulic or pneumatic amplification, instead of electromagnetic forces, to generate opposing forces to act, and overcome, the flow forces generated during activation of the modular apparatus ~~10~~ 50 ~~valve~~, which, in turn, requires relatively low current levels to generate sufficient forces.

Because of the decreased power requirements, the modular apparatus ~~10~~ 50 can be operated in an intrinsically safe mode, and is thereby capable of use in hazardous environments. In addition, unlike with the prior art apparatus 10, low power cabling can be used with the

modular apparatus 50. Furthermore, the low current application also allows incorporating one or more light-emitting diodes ("LEDs") (not shown) to the coil of the modular apparatus 50 to depict coil energization and de-energization, whereas the prior art apparatus 10 required high powered and expensive lightings for diagnosing, for example, the status of electromagnetic coils.

➢ **Please replace the paragraph at page 22, lines 6-14 with the following:**

In addition, a preferred PSM 58 contains a microprocessor, allowing much of the functionality thereof to be controlled by software protocols. For example, surface mounting electronic components can be additionally incorporated onto a driver board to decrease cost, space requirements, and enable higher temperature operation. Moreover, the microprocessor allows changing the functionality of the modular apparatus 50 by changing software system gain components instead of hardware. In addition, a suitable microprocessor device, as understood by one skilled in the art, enables monitoring or control of the modular apparatus 50 through a remote computer operator, acting, for example, through ~~the~~ a personal computer, modem, or the Internet.

➢ **Please replace the paragraph at page 23, lines 7-12 with the following:**

Functionally, the DM 122 facilitates diagnostic troubleshooting and other engineering evaluation of the modular ~~system~~ apparatus 50'. The LSM 124 senses the highest load pressure between the two working ports A, B and connects the appropriate port to the load sense port L. The PFSM 126 provides position, pressure, flow, velocity, speed, torque, temperature, or other types of feedback to ~~allows~~ enable the modular apparatus 50' to operate as a servo system. And the MOM 128 allows manually ~~control~~ controlling the positioning of the sliding spool 18 if necessary.

➢ **Please replace the paragraph at page 23, line 17 through page 24, line 2 with the following:**

Referring now to FIG. 10, the PRM 120 is shown. More specifically, the PRM 120 contains a bottom surface 130 for interfacing with the VBM 52 through the standard mounting pattern 44 and a top surface 132 for interfacing with the PCM 54 or the LSM ~~120~~ 124 if the LSM ~~120~~ 124 is included. Preferably, the PRM 120 also contains a pressure reducing valve cartridge ("PRVC") 134 at one distal end thereof, and a well-known SAE plug 136 at the other distal end thereof. If, on the other hand, the PCVA 80 is rated for, say, up to 5000 psi, the PRM 120 can be avoided if the modular apparatus 50' is not exposed to such pressures. In any event, the PRM

120 regulates pressure to the PCM 54, which, in turn, coordinates supplying regulated pressure to the VBM 52.

➢ **Please replace the paragraph at page 24, lines 8-18 with the following:**

Referring now to FIG. 12, the DM 122 is shown. More specifically, the DM 122 contains a pressure transducer 140 external to a body 142 of the DM 122. Within the body 142 of the DM 122, the pressure transducer 140 is in communication with a shuttle valve assembly ("SVA") 144 that operates between the two working ports A, B. The SVA 144 is further connected to a SAE plug 146. In operation, the highest load pressure will connect either of the two working ports A, B to the pressure transducer 140. Accordingly, appropriate data can be provided to a computing device to calculate, for example, cycle timing for the modular ~~system~~ apparatus 50'. In any event, the DM 122 communicates functional data about the modular apparatus 50', including, for example, data regarding load pressures, load flows, load fluid temperatures, and the like. Preferably, transducers built into the DM 122 relay the functional data to hand-held or remotely located receiving devices (not shown), preferably through a conventional RS-232 port or the like.

➢ **Please replace the paragraph at page 26, line 14 through page 27, line 3 with the following:**

Likewise, the MOM 128 is also preferably connected directly to the sliding spool 18 of the VBM 52 in order to be able to manually control the positioning of the sliding spool 18 in the event of a coil burn-out, wire fretting, wire cutting, pilot control contamination, or the like, related to the electrical signals from the PCM 54 and PSM 58. Preferably, the MOM 128 is a threaded, attached plate module with over-ride options including mechanical hand lever operation, manual push-pull operation, cable linkage push-pull operation, remote operation, hydraulic operation, pneumatic operation, and the like, all of which permit manual operation of the VBM 52. Regardless, locating the PCM ~~56~~ 54 and PSM 58 above the VBM 52 permits direct linking to the ~~main~~ sliding spool 18 of the VBM 52 for manual operation, whereas in the prior art apparatus 10, manual override devices had to be connected to the armature of the one or more high power solenoids 26 instead of directly to the sliding spool 18. In any event, the MOM 128 permits manual control of the VBM 52 in case, for example, there is a sudden or unexpected lack of input power to the PCM 54.

➢ **Please replace the paragraph at page 27, lines 5-8 with the following:**

At least two types of mountings are possible for the modular apparatus 50, 50' of the present invention, including ~~singly~~ single sub-plate mounting and bar manifold mounting. Accordingly, single sub-plate mounting is shown in FIG. 15, and bar manifold mounting is shown in FIG. 16, as well-known in the art.

➢ **Please replace the three (3) paragraphs at page 27, line 10 through page 28, line 22 with the following:**

Referring now to FIG. 17, the PCM 54 and PSM 58 can be connected remotely from the VBM 52, as previously mentioned, in which an electronic control module 160 permits remote operation of the PCM 54 and PSM 58 to control operation of the VBM 52. More specifically, a housing 162 (shown with cover removed) encloses one or more microprocessor modules 164, 166, which can be used to control and monitor the modular apparatus 50, 50'. By techniques known in the art, one or more serial ports 168 can be used to communicate between the one or more microprocessor modules 164, 166, and modular apparatus 50, 50', including, utilizing, for example, interfacing components such as valve outputs 170, command inputs 172, and power inputs 174. Accordingly, the one or more serial ports 168 relay functional data to hand-held or remotely located receiving devices (not shown). Representative microprocessor modules 164, 166 are available from Parker Hannifin Corporation of Cleveland, Ohio, Part Number IQAN-TOC-2, as well as other commercially-available, suitable products. In a preferred embodiment, the representative microprocessor modules 164, 166 have an operating temperature of -40° C to +70° C, supply voltage of 9 volts DC to 24 volts DC, and are capable of controlling up to four or more modular apparatuses 50, 50'.

To power the electronic module 160, a PSM 58' preferably operates in conjunction with a programmable logic control ("PLC") device 176. A representative PSM 58' is available from Moeller Electric Corporation of Franklin, Massachusetts, Part Number EASY 400-POW, as well as other commercially-available, suitable products. In a preferred embodiment, the PSM 58' has an operating temperature of -25° C to +55° C, input supply voltages of 90-375 volts DC, 85-264 volts AC, and 43-67 Hertz at 1.25 amps, and output voltages of 9-24 volts DC. Preferably, it is capable of controlling up to four or more modular apparatuses 50, 50'. A representative PLC device 176 is available from Moeller Electric Corporation of Franklin, Massachusetts, Part Number EASY 412-AC-DC Relay, as well as other commercially-available, suitable products. In a preferred embodiment, the PLC device 176 has an operating temperature of -25° C to +55°

C, input supply voltages of 90-264 volts AC, 50-60 Hertz at 40 milli amps or less, eight digital inputs, preferably at a low of 0 volts AC to 40 volts AC and a high of 79 volts AC to 264 volts AC, and outputs on four isolated relay outputs rated at 8 amps at 250 volts AC. Preferably, it can be networked, utilizes front display and programming keys, forty-one lines of logic, and eight counters or timers, including a daily or weekly or monthly or yearly timer. An optional memory card can be used, and expansion units are available. Parameters can be changed from the display, and password protection can be utilized if desired. Preferably, it is capable of controlling up to four or more modular apparatuses 50, 50'.

As described, the ability to control multiple modular apparatuses 50, 50' is particularly beneficial with bar manifold mounting, as shown in FIG. 16.

➢ **Please replace the three (3) paragraphs at page 29, line 2 through page 30, line 4 with the following:**

Having now described the modular apparatus 50, 50', including its four principal modules (i.e., the VBM 52, PCM 54, TIM 56, and PSM 58) and five optional modules (i.e., the PRM 120, DM 122, LSM 124, PFSM 126, and MOM 128), several of its operational benefits will now also be described for representative, and therefore non-limiting, purposes.

Relative to the prior art apparatus 10, the modular apparatus 50, 50' provides a modular, more compact, smaller envelope, lower power, lighter weight, faster, and more responsive design, preferably capable of on-off, proportional, and servo operation. Two-way, three-way, and four-way direct and pilot control functionality is provided, as is JIC, CETOP, and ISO mounting compatibilities, suitable for both sub-plate and bar manifold mountings. Due to the modular design, manufacturing, maintenance, field repairs, and changes are simplified, as well as requiring fewer parts in inventories. For example, by incorporating a PSM 58 that is capable of i) 12-48 volts DC input to 12 volts DC output power supply conversion, and ii) 120-240 volts AC input to 12 volts DC output power supply conversion at 50-60 Hertz, global input voltage and frequencies can be accommodated by the single module, allowing interoperability throughout the world. Accordingly, separately stocking one or more of 12 volts DC, 24 volts DC, 120 volts AC, 240 volts AC, and 460 volts AC coils, as well as separate solenoids for on-off, proportional, and servo operations, are no longer required. In addition, one or more of pressure reducing, diagnostic, load sensing, position feedback sensoring, and manual operation capabilities can be provided, as needed or desired. For example, by imparting pressure reducing

capabilities internal to the modular apparatus 50, 50' via the PRM 120, the internal reducing allows lower pilot pressure requirements, which, in turn, allow low power requirements from the PSM 58 as opposed to the one or more solenoids 26 of the prior art apparatus 10.

As previously mentioned, on-off, proportional, and servo operations can also be accommodated by a single module. Moreover, in a preferred embodiment, commercially available hardware is used for the PCM ~~154~~ 54, TIM 56, PSM 58, PRM 120, DM 122, LSM 124, PFSM 126, and MOM 128.

➤ **From page 41, lines 2-11, please replace the Abstract of the Disclosure with the following:**

~~A valve~~ Valve base module ~~comprising~~ comprises a tank core passage extending ~~through~~ within a ~~non-vertical~~ plane ~~defined by~~ containing a longitudinal axis ~~and a non-vertical cross-section extending through said valve housing~~, said plane oriented in non-perpendicular relation to a surface of said valve housing comprising at least a P, T, A, and B port and standard mounting holes for mounting said valve base module to at least one of a sub-plate or bar manifold. The ~~non-vertical~~ plane is disposed at an offset angle α relative to a ~~vertical~~ second plane to ~~permits~~ permit one or more of at least P, T, A, and B ports to connect a ~~bottom~~ first surface to ~~a top~~ an opposing second surface of the valve housing to form one or more of at least P', T', A', and B' ports that permit the following additional modules to be mounted ~~thereon, including,~~ thereto: a pilot control ~~module (including a pilot control valve assembly)~~ PCM, thermal insulating ~~module~~ TIM, power supply ~~module~~ PSM, pressure reducing ~~module (including a pressure reducing valve cartridge)~~ PRM, diagnostic ~~module (including a shuttle valve assembly)~~ DM, load sense ~~module~~ LSM, position feedback sensor ~~module~~ PFSM, and manual override ~~module~~ MOM~~, wherein the bottom surface conforms to a standard mounting pattern~~.